WHAT IS CLAIMED IS:

1. An exposure apparatus which exposes an object with an illumination beam irradiated on a mask from a light source, comprising:

an illumination optical system disposed on an optical path along which the illumination beam passes to illuminate the mask with the illumination beam through an optical integrator; and

an optical unit disposed between the light source and the optical integrator in the illumination optical system to form different intensity distributions of the illumination beam on a Fourier transform plane with respect to a pattern surface of the mask, the optical unit including a deflection optical element that generates a deflected beam in a different direction from an optical axis of the illumination optical system to form one of the different intensity distributions having an increased intensity portion apart from the optical axis relative to a portion of the one intensity distribution on the optical axis, an optical element movable along the optical axis and a zoom optical system to adjust at least one of the different intensity distributions.

2. An apparatus according to Claim 1, wherein

said optical unit adjusts a positional relationship between said optical axis and an increased intensity portion of said at least one intensity distribution on said Fourier transform plane by at least one of said movable optical element and said zoom optical system.

3. An apparatus according to Claim 2, wherein

said optical unit adjusts a size of an increased intensity portion of said at least one intensity distribution on said Fourier transform plane by said zoom optical system.

4. An apparatus according to Claim 3, wherein

said movable optical element includes at least one prism on said optical axis.

5. An apparatus according to Claim 4, wherein

said one intensity distribution has a plurality of increased intensity portions of which distances from said optical axis, in a direction along which linear features on said mask are arranged, are substantially equal.

6. An apparatus according to Claim 5, wherein

said optical unit includes an optical member to define said plurality of increased intensity portions.

7. An apparatus according to Claim 6, wherein

said optical member is disposed between said optical integrator and said mask.

8. An apparatus according to Claim 1, wherein

said optical unit adjusts at least one of a size and a position of an increased intensity portion of said at least one intensity distribution on said Fourier transform plane by at least one of said movable optical element and said zoom optical system.

9. An apparatus according to Claim 8, wherein

said deflection optical element restrains generation of a beam in a direction along said optical axis.

10. An apparatus according to Claim 9, wherein

said movable optical element includes at least one prism on said optical axis.

11. An exposure apparatus which exposes an object with an illumination beam irradiated on a mask from a light source, comprising:

an illumination optical system disposed on an optical path along which the illumination beam passes to illuminate the mask with the illumination beam through an optical integrator;

an optical unit disposed between the light source and the optical integrator in the illumination optical system to form different intensity distributions of the illumination beam, on a Fourier transform plane with respect to a pattern surface of the mask, of which one intensity distribution has a plurality of increased intensity portions apart from an optical axis of the illumination optical system relative to a portion of the one intensity distribution on the optical axis; and

a driving system connected with at least a part of the optical unit to adjust positions of each of the plurality of increased intensity portions in a first direction and a second direction perpendicular to the first direction on the Fourier transform plane, respectively.

12. An apparatus according to Claim 11, wherein

said positions of each of the plurality of increased intensity portions are adjusted so that first distances in said first direction between said plurality of increased intensity portions and said optical axis are substantially equal and second distances in said second direction between said plurality of increased intensity portions and said optical axis are substantially equal.

13. An apparatus according to Claim 12, wherein said first distances are determined in accordance with a first pitch of a pattern on said mask in said first direction, and said second distances are determined in accordance with a second pitch of the pattern on said mask in said second direction.

14. An apparatus according to Claim 13, wherein said optical unit includes an optical member to define said plurality of increased intensity portions.

15. An apparatus according to Claim 11, wherein said optical unit includes a deflection optical element that generates deflected beams in different directions from said optical axis to form said one intensity distribution.

16. An apparatus according to Claim 15, wherein said optical unit includes a zoom optical system to adjust at least one of said different intensity distributions.

17. An apparatus according to Claim 16, wherein said optical unit includes an optical element movable along said optical axis to adjust at least one of said different intensity distributions.

18. An apparatus according to Claim 15, wherein said deflection optical element is a diffraction optical element that restrains generation of a beam in a direction along said optical axis.

19. An apparatus according to Claim 15, wherein said deflection optical element is a phase shift type diffraction optical element.

20. An apparatus according to Claim 18, wherein

said optical unit includes a zoom optical system and an optical element movable along said optical axis to adjust at least one of said different intensity distributions.

21. An exposure apparatus which exposes an object with an illumination beam irradiated on a mask from a light source, comprising:

an illumination optical system disposed on an optical path along which the illumination beam passes to illuminate the mask with the illumination beam through an optical integrator;

an optical unit disposed between the light source and the optical integrator in the illumination optical system to form different intensity distributions of the illumination beam on a Fourier transform plane with respect to a pattern surface of the mask, wherein the optical unit includes a deflection optical element to form a first one of the different intensity distributions having a plurality of increased intensity portions, apart from an optical axis of the illumination optical system relative to a portion of the first intensity distribution on the optical axis, of which distances from the optical axis are substantially equal, and to form a second one of the different intensity

distributions different from the first intensity distribution by exchange of the deflection optical element.

22. An apparatus according to Claim 21, wherein said deflection optical element generates deflected beams in different directions from said optical axis.

23. An apparatus according to Claim 22, wherein said deflection optical element is a diffraction optical element that restrains generation of a beam in a direction along said optical axis.

24. An apparatus according to Claim 22, wherein said deflection optical element is a phase shift type diffraction optical element.

25. An apparatus according to Claim 23, wherein said diffraction optical element is disposed on a plane substantially conjugate with the pattern surface of said mask in said illumination optical system.

26. An apparatus according to Claim 23, wherein

said optical unit includes a zoom optical system to adjust at least one of said different intensity distributions.

27. An apparatus according to Claim 22, wherein said deflection optical element is a polyhedron prism on said optical axis.

28. An apparatus according to Claim 27, wherein said optical unit includes a zoom optical system to adjust at least one of said different intensity distributions.

29. An apparatus according to Claim 22, wherein said optical unit determines each position of said plurality of increased intensity portions so that first distances in a first direction along which linear features on said mask are arranged, between said plurality of increased intensity portions and said optical axis, are substantially equal.

30. An apparatus according to Claim 29, wherein

said optical unit determines the position of each of said plurality of increased intensity portions so that second distances in a second direction perpendicular to said first direction, between said plurality of increased intensity portions and said optical axis, are substantially equal.

31. An exposure apparatus which exposes an object through a projection optical system, with an illumination beam irradiated on a mask from a light source, comprising:

an illumination optical system disposed on an optical path along which the illumination beam passes to illuminate the mask with the illumination beam through an optical integrator;

an optical unit disposed between the light source and the optical integrator in the illumination optical system to form different intensity distributions of the illumination beam on a Fourier transform plane with respect to a pattern surface of the mask, wherein the optical unit includes a diffraction optical element that generates a diffraction beam in a direction different from an optical axis of the illumination optical system to form one of the different intensity distributions having an increased intensity

portion apart from the optical axis relative to a portion of the one intensity distribution on the optical axis.

32. An apparatus according to Claim 31, wherein said one intensity distribution has a plurality of increased intensity portions of which distances from said optical axis are substantially equal, and said diffraction optical element generates diffraction beams in directions substantially symmetrical with respect to said optical axis.

33. An apparatus according to Claim 32, wherein said diffraction optical element restrains generation of a diffraction beam in a direction along said optical axis.

34. An apparatus according to Claim 32, wherein said diffraction optical element is a phase shift type optical element.

35. An apparatus according to Claim 32, wherein said diffraction optical element is disposed on a plane substantially conjugate with the pattern surface of said mask in said illumination optical system.

36. An apparatus according to Claim 32, wherein said optical unit includes a zoom optical system to adjust at least one of said different intensity distributions.

37. An apparatus according to Claim 31, wherein said one intensity distribution has a plurality of increased intensity portions of which distances from said optical axis are substantially equal and of which each position is determined in accordance with a pattern on said mask to be transferred onto said object.

38. An apparatus according to Claim 37, wherein said each position of the plurality of increased intensity portions is determined so that an optical gravity center of said one intensity distribution is substantially coincident with said optical axis.

39. An apparatus according to Claim 37, wherein

said each position of the plurality of increased intensity portions is determined so that two diffracted beams having different order, generated from said pattern by irradiation of the illumination beam from one of said plurality of increased intensity portions, pass through regions apart from an optical axis of said projection optical system on a pupil plane of said projection optical system, of which distances from the optical axis of said projection optical system are substantially equal.

40. An apparatus according to Claim 37, wherein said each position of the plurality of increased intensity portions is determined so that an incident angle of the illumination beam from one of said plurality of increased intensity portions satisfies the following relation:

$$\sin \theta = \lambda/2P$$

where $\theta$ is the incident angle, $\lambda$ is a wavelength of the illumination beam, and P is a pitch of said pattern.

41. An apparatus according to Claim 37, wherein said each position of the plurality of increased intensity portions is determined so that a first diffracted beam generated from said pattern by irradiation of the illumination beam from a first portion of said plurality of increased intensity portions, and a second diffracted beam having different order from the first diffracted beam, generated from said pattern by irradiation of the illumination beam from a second portion of said plurality of increased intensity portions different from the first portion, substantially pass through a first region apart from an optical axis of said projection optical system on a pupil plane of said projection optical system.

42. An apparatus according to Claim 41, wherein said each position of the plurality of increased intensity portions is determined so that a third diffracted beam having different order from said first diffracted beam, generated from said pattern by irradiation of the illumination beam from said first portion, and a fourth diffracted beam having different order from the second and third diffracted beams, generated from said pattern by irradiation of the illumination beam from said second portion, substantially pass through a second region apart

from the optical axis of said projection optical system on the pupil plane of said projection optical system, and the first and second regions have substantially same distance from the optical axis of said projection optical system.

43. An apparatus according to Claim 37, wherein said each position of the plurality of increased intensity portions is determined so that a 0-order diffracted beam generated from said pattern by irradiation of the illumination beam from one of said plurality of increased intensity portions, a non-0-order diffracted beam distributed in a first direction about the 0-order diffracted beam, and a non-0-order diffracted beam distributed in a second direction about the 0-order diffracted beam, are distributed on a pupil plane of said projection optical system and at substantially equal distances from an optical axis of said projection optical system.

44. An apparatus according to Claim 37, wherein a minimum pitch of said pattern is defined to be:

$\lambda / (NA_R + \sin \Phi)$

where $\Phi$ is an incident angle of the illumination beam from each of one of said plurality of increased intensity

portions, $\lambda$ is a wavelength of the illumination beam, and $NA_R$ is a numerical aperture of said projection optical system.

45. An apparatus according to Claim 37, wherein said pattern includes a periodic feature whose pitch is smaller than $\lambda/NA_R$, where $\lambda$ is a wavelength of said illumination beam, and $NA_R$ is a numerical aperture of said projection optical system.

46. An apparatus according to Claim 37, wherein said plurality of increased intensity portions are disposed on a pair of first line segments substantially parallel to a first direction in which said pattern extends and substantially symmetrical with respect to the optical axis of said illumination optical system.

47. An apparatus according to Claim 46, wherein said pair of first line segments are defined apart from the optical axis of said illumination optical system by a first distance in a second direction perpendicular to said first direction, determined in accordance with fineness of said pattern in the second direction.

48. An apparatus according to Claim 46, wherein said plurality of increased intensity portions are disposed on said pair of first line segments and a pair of second line segments substantially parallel to a second direction perpendicular to said first direction and substantially symmetrical with respect to the optical axis of said illumination optical system.

49. An apparatus according to Claim 48, wherein said pair of second line segments are defined apart from the optical axis of said illumination optical system by a second distance in said first direction, determined in accordance with fineness of said pattern in said first direction.

50. An apparatus according to Claim 48, wherein said plurality of increased intensity portions are crossing points of said pair of first line segments and said pair of second line segments.

51. A method of exposing an object through a projection optical system, with an illumination beam irradiated on a mask from a light source by an illumination optical system, comprising:

disposing a diffraction optical element that generates a diffraction beam in a direction different from an optical axis of the illumination optical system, between the light source and an optical integrator of the illumination optical system to illuminate the mask with the illumination beam, of which an intensity distribution on a Fourier transform plane with respect to a pattern surface of the mask has an increased intensity portion apart from the optical axis relative to a portion of the intensity distribution on the optical axis; and

projecting onto the object the illumination beam from the illuminated mask.

52. A method according to Claim 51, wherein

said intensity distribution has a plurality of increased intensity portions of which distances from said optical axis are substantially equal, and said diffraction optical element generates diffraction beams in directions substantially symmetrical with respect to said optical axis.

53. A method according to Claim 52, wherein

said intensity distribution of the illumination beam is changed by at least one of exchange of said diffraction optical element and movement of a zoom optical system

disposed between said light source and said optical integrator.

54. A method according to Claim 51, wherein said intensity distribution has a plurality of increased intensity portions of which distances from said optical axis are substantially equal and of which each position is determined in accordance with a pattern on said mask to be transferred onto said object.